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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/912,103	07/23/2001	Huong Thanh Nguyen	5619/DD/LOW K/JW	4476
32588	7590	02/22/2006	EXAMINER	
APPLIED MATERIALS, INC. 2881 SCOTT BLVD. M/S 2061 SANTA CLARA, CA 95050			NGUYEN, KHIEM D	
			ART UNIT	PAPER NUMBER
			2823	

DATE MAILED: 02/22/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

**Office Action Summary**

Application No.

09/912,103

Applicant(s)

NGUYEN ET AL.

Examiner

Khiem D. Nguyen

Art Unit

2823

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 02 December 2005.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1-24 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1-24 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 23 July 2001 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- |  |   |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892)  | 4) <input type="checkbox"/> Interview Summary (PTO-413)<br>Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948)                                   | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152)             |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)<br>Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____  |

FIG. 4A

(c) forming a silicon oxide layer 420 on the first organosilicate layer 416; (d) forming a second organosilicate layer 424 on the silicon oxide layer 420 (col. 2, line 46 to col. 3, line 21 and FIGS. 4A-B); and

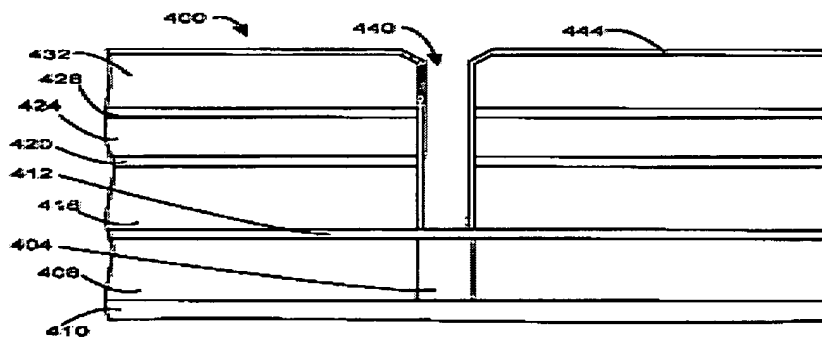


FIG. 4B

(e) etching the second organosilicate layer 424 to define vias 440 therein, wherein the second organosilicate layer 424 is etched with a gas mixture comprising a hydrogen-containing fluorocarbon and one or more gases selected from the group consisting of hydrogen (H<sub>2</sub>), nitrogen (N<sub>2</sub>), oxygen (O<sub>2</sub>), argon (Ar), and helium (He) (col. 4, lines 9-67).

In re claim 2, Annapragada discloses that the method of claim 1, further comprising:

(f) etching the silicon oxide layer 420 to transfer the vias 440 defined in the second organosilicate layer 424 therethrough (FIG. 4C);

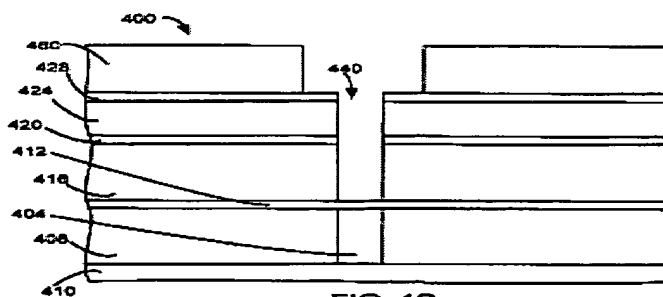


FIG. 4C

(g) patterning the second organosilicate layer **424** to define interconnects **464** therethrough, wherein the interconnects **464** are positioned over the vias **440**, and wherein the via pattern is transferred through the first organosilicate layer **416** when the interconnects **464** are defined in the second organosilicate layer **424** (FIG. 4D); and

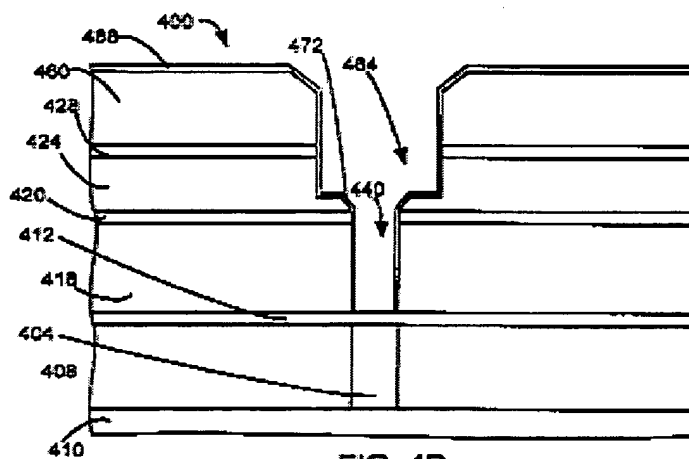


FIG. 4D

(g) filling the vias **440** and interconnects **464** with a conductive material. The dual damascene structure as disclosed by Annapragada in FIGS. 4D-E eventually will be filled with a conductive material selected from the group consisting of copper, aluminum or tungsten to obtain an interconnect structure.

In re claim 3, Annapragada discloses that the interconnects **464** are defined in the second organosilicate layer **424** and the vias **440** are defined in the first organosilicate layer **416** using a hydrogen-containing fluorocarbon gas mixture (col. 4, lines 9-67).

In re claim 4, Annapragada inherently discloses that the conductive material filling the vias **440** and interconnects **464** is selected from the group of copper (Cu), aluminum (Al), tungsten (W), and combinations thereof. The dual damascene structure as disclosed by Annapragada in FIGS. 4D-E eventually will be filled with a conductive

material selected from the group consisting of copper, aluminum or tungsten to obtain an interconnect structure.

In re claim 5, Annapragada discloses that the gas mixture includes one or more gases selected from the group consisting of trifluoromethane ( $\text{CHF}_3$ ), difluoromethane ( $\text{CH}_2\text{F}_2$ ), and fluoromethane ( $\text{CH}_3\text{F}$ ) (col. 4, lines 9-23).

In re claim 6, Annapragada discloses that the gas mixture further comprises a gas selected from the group consisting of carbon tetrafluoride ( $\text{CF}_4$ ) and fluoroethane ( $\text{C}_2\text{F}_6$ ), and combination thereof (col. 4, lines 9-23).

In re claim 7, Annapragada discloses that the gas mixture includes hydrogen ( $\text{H}_2$ ) (col. 4, lines 9-23).

In re claim 9, Annapragada discloses that the second organosilicate layer is etch at a pressure within a range of about 100-2000 mtorr (col. 4, Table 1).

In re claim 10, Annapragada discloses that the method of claim 1, further comprising applying an electric field to the hydrogen-containing fluorocarbon gas mixture (col. 3, lines 22-52).

In re claim 11, Annapragada discloses that the electric field is a radio frequency (RF) power (col. 3, lines 22-52).

In re claim 12, Annapragada discloses that the RF power is within a range of about  $1\text{ watt/cm}^2$  to about  $100\text{ watts/cm}^2$  (col. 4, lines 9-67).

In re claim 13, Annapragada discloses that the silicon oxide layer 420 is etched with a fluorocarbon gas mixture (col. 4, lines 9-23).

In re claim 14, Annapragada discloses that the fluorocarbon gas mixture further comprises a gas selected from the group consisting of carbon tetrafluoride ( $\text{CF}_4$ ) and fluoroethane ( $\text{C}_2\text{F}_6$ ), and combination thereof (col. 4, lines 9-23).

In re claim 15, Annapragada discloses that the fluorocarbon gas mixture further includes one or more gases selected from the group consisting of hydrogen ( $\text{H}_2$ ), nitrogen ( $\text{N}_2$ ), oxygen ( $\text{O}_2$ ), argon (Ar), and helium (He) (col. 4, lines 9-23).

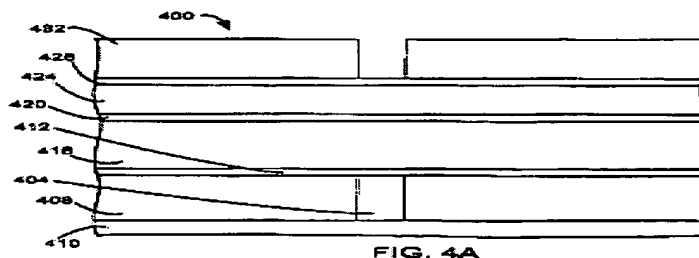
In re claim 17, Annapragada discloses that the silicon oxide layer 420 is etch at a pressure within a range of about 100-2000 mTorr (col. 4, Table 1).

In re claim 18, Annapragada discloses that the method of claim 1, further comprising applying an electric field to the hydrogen-containing fluorocarbon gas mixture (col. 3, lines 22-52).

In re claim 19, Annapragada discloses that the electric field is generated using a radio frequency (RF) power (col. 3, lines 22-52).

In re claim 20, Annapragada discloses that the RF power is within a range of about 1 watt/cm<sup>2</sup> to about 100 watts/cm<sup>2</sup> (col. 4, Table 1).

In re claim 21, Annapragada discloses a method of fabricating a damascene structure, comprising: (a) forming a barrier layer 412 on a substrate 410 having a metal layer 404 thereon; (b) forming a first organosilicate layer 416 on the barrier layer 412;



(c) forming a silicon oxide layer 420 on the first organosilicate layer 416; (d) forming a second organosilicate layer 424 on the silicon oxide layer 420 (col. 2, line 46 to col. 3, line 21 and FIGS. 4A-B); and

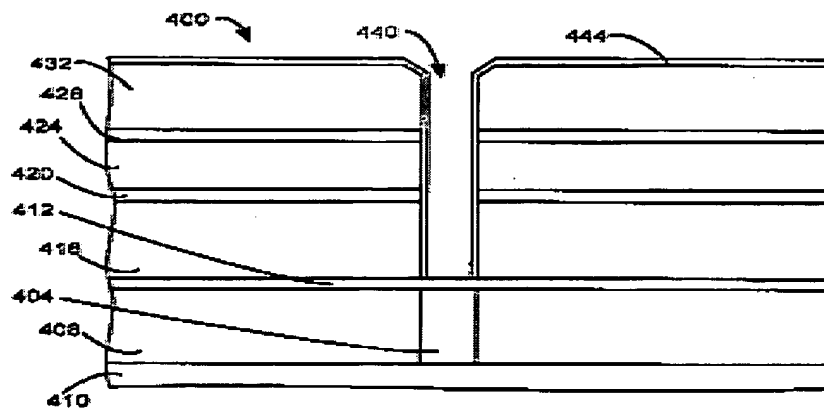


FIG. 4B

(e) etching the second organosilicate layer 424 to define vias 440 therein, wherein the second organosilicate layer 424 is etched with a gas mixture comprising one or more hydrogen-containing fluorocarbon gases and one or more gases selected from the group consisting of hydrogen ( $H_2$ ), nitrogen ( $N_2$ ), oxygen ( $O_2$ ), argon (Ar), and helium (He) (col. 4, lines 9-23); and

(f) etching the silicon oxide layer 420 to transfer the vias 440 defined in the second organosilicate layer 424 therethrough, wherein the silicon oxide 420 is etched with a gas mixture comprising a fluorocarbon gas (col. 9, lines 9-23);

In re claim 22, Annapragada discloses that the gas mixture for etching the second organosilicate layer 424 comprises hydrogen ( $H_2$ ) (col. 9, lines 4-67).



In re claim 23, Annapragada discloses that the gas mixture for etching the second organosilicate layer 424 comprises trifluoromethane (CHF<sub>3</sub>), dimethylfluoride, and hydrogen (col. 4, lines 9-23).

In re claim 24, Annapragada discloses that the gas mixture for etching the second organosilicate layer 424 comprises difluoromethane, tetrafluoride, and hydrogen (col. 4, lines 9-23).

### *Claim Rejections - 35 USC § 103*

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

Claims 8 and 16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Annapragada et al. (U.S. Patent 6,518,174).

In re claims 8 and 16, Annapragada does not explicitly disclose that the second organosilicate layer is etched at a temperature within a range of about -20°C to about 80°C. However, there is no evidence indicating the temperature range is critical and it has been held that it is not inventive to discover the optimum or workable temperature range of a result-effective variable within given prior art conditions by routine experimentation. See MPEP § 2144.05.

Note that the specification contains no disclosure of either the critical nature of the claimed dimensions of any unexpected results arising there from. Where patentability is aid to be based upon particular chosen dimensions or upon another variable recited in a

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claim, the Applicant must show that the chosen dimensions are critical. In re Woodruff, 919 F.2d 1575, 1578, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).


***Conclusion***

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Khiem D. Nguyen whose telephone number is (571) 272-1865. The examiner can normally be reached on Monday-Friday (8:30 AM - 5:30 PM).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Matthew S. Smith can be reached on (571) 272-1907. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

K.N.  
February 16, 2006



**W. DAVID COLEMAN  
PRIMARY EXAMINER**